Source Attribution of Mercury Deposition to the Four Corners Region, Southwestern United States

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EPRI, Palo Alto, California

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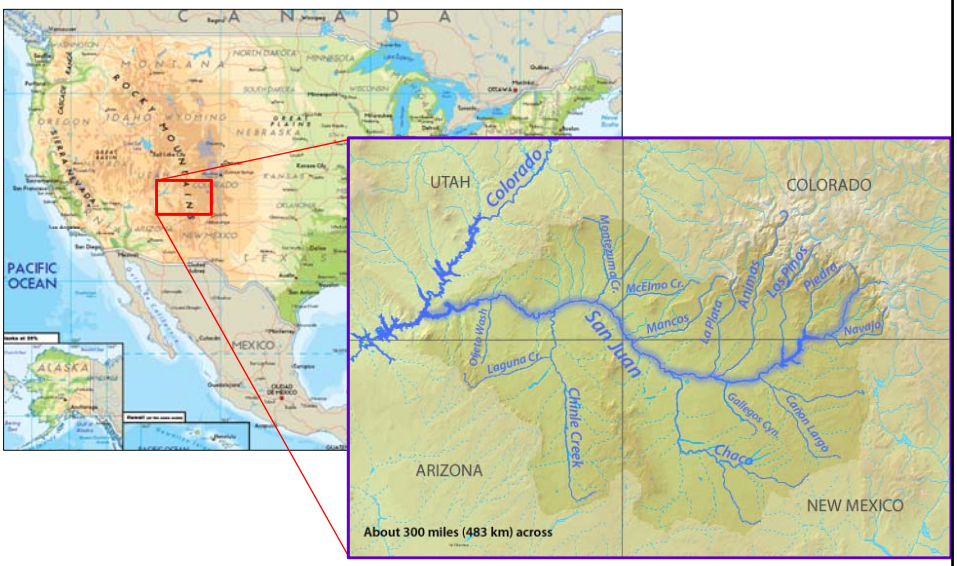
Model Domain: San Juan River basin



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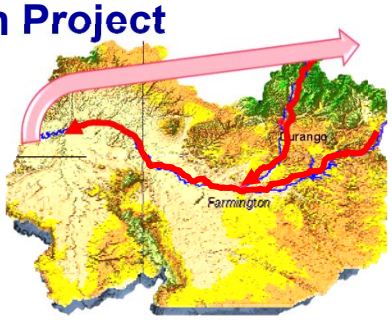
The San Juan River Basin Project

- Integrated air/watershed study of 64,000 square mile region
- Contributions of local, global mercury sources to watershed concentrations
- Target species: top predator fish



- ***How much do local sources contribute to toxics loading in the San Juan River basin?***
- ***How do these contributions change through 2074?***
- ***Are these significant contributions to the ecosystem?***

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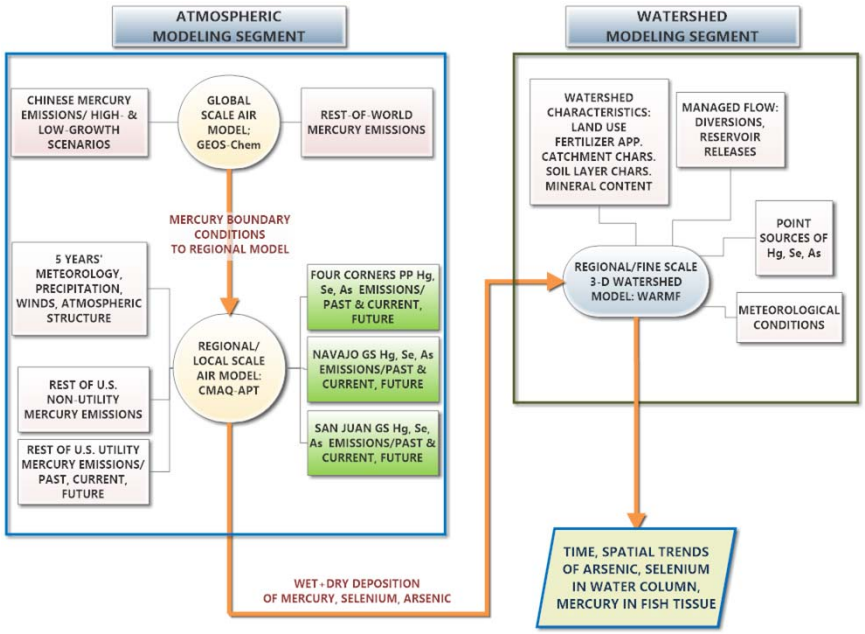

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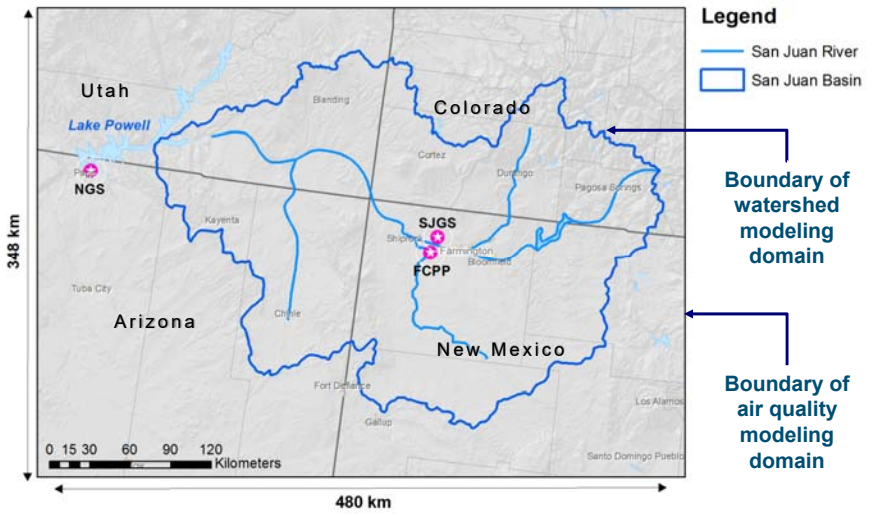
Regional Modeling Domains



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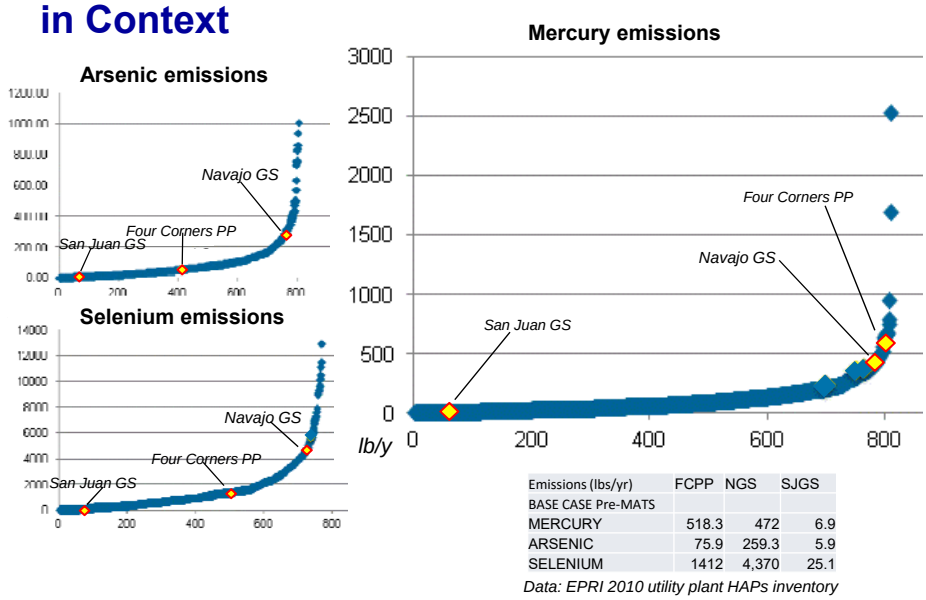
Four Corners Region Utility Stack Emissions in Context



Emissions (lbs/yr)	FCPP	NGS	SJGS
BASE CASE Pre-MATS			
MERCURY	518.3	472	6.9
ARSENIC	75.9	259.3	5.9
SELENIUM	1412	4,370	25.1

Data: EPRI 2010 utility plant HAPs inventory

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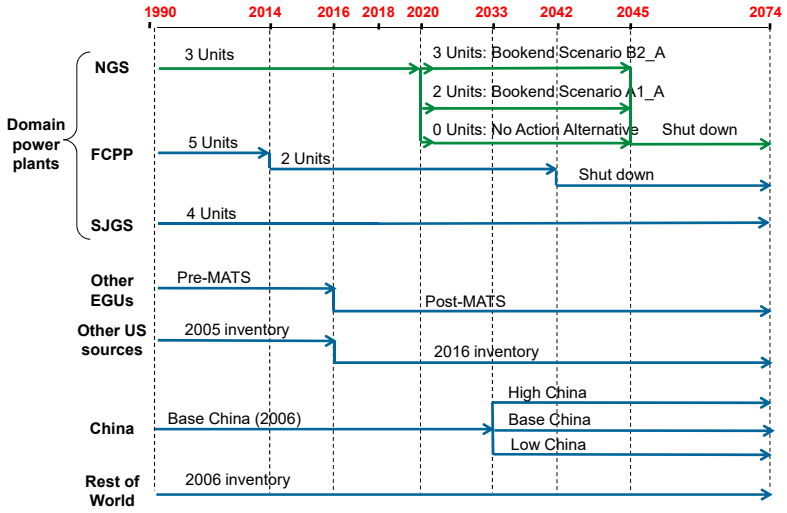
Modeled Timeline of Mercury Air Emissions



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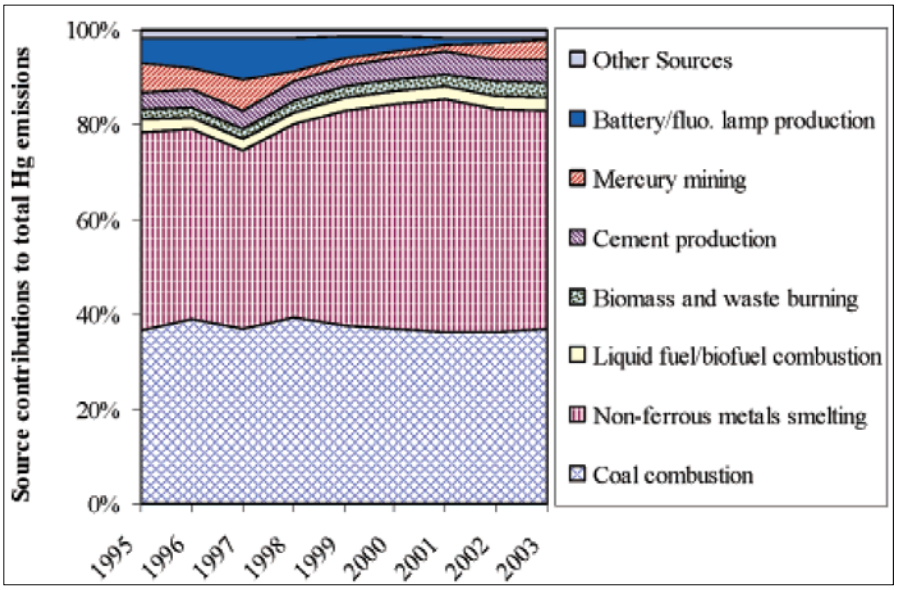
Characterizing the China source: D. Streets (2009)



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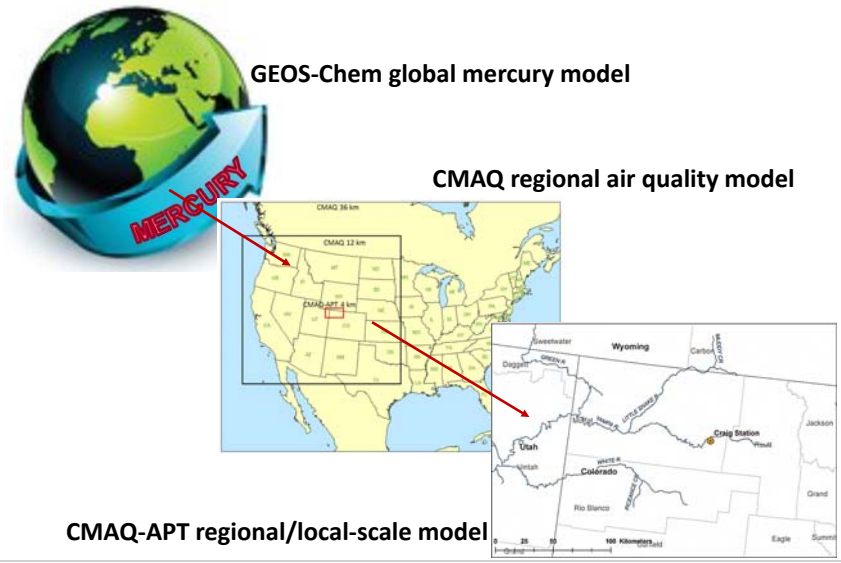
Linked Air Quality Models to Account For Mercury Sources at Different Scales



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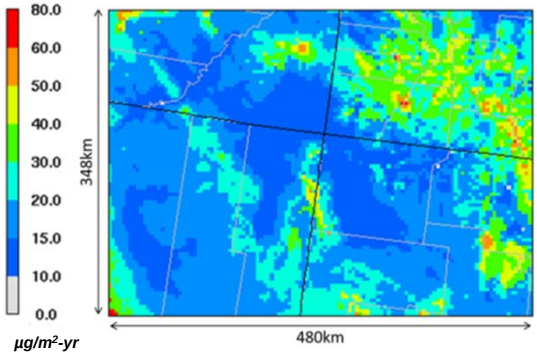
Hg_{tot} deposition flux due to all sources vs. observations



- Hg^{II} + Hg_p deposition > 90% of (wet+dry) deposition of total Hg
- Model comparison with observations at Mesa Verde National Park
  - Wet deposition within 14% of MDN measurements (under-prediction)
  - Dry deposition within 34% of EPA (2004) measurements (over-prediction)
  - Total deposition within 11% (over-prediction)

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Modeling Scenarios: Summary & Comparison

Emission Scenarios	Navajo Generating Station	China Mercury Emissions	Demonstrated Effects
N1, N2, N3	3 units 1986-2044 0 units 2045-2074	Base 1986-2032 High 2033-2074	EFFECTS OF HIGH CHINA MERCURY EMISSIONS GROWTH
N4, N5, N6	3 units 1986-2044 0 units 2045-2074	Base 1986-2032 Low 2033-2074	EFFECTS OF LOW CHINA MERCURY EMISSIONS GROWTH
N7, N8, N9	3 units 1986-2044 0 units 2045-2074	Base 1986-2074	BASE CASE "BUSINESS AS USUAL" CHINA MERCURY EMISSIONS GROWTH

Details apply to mercury scenarios; for arsenic & selenium, scenarios are limited to NGS, SJGS, and FCPP emissions scenarios

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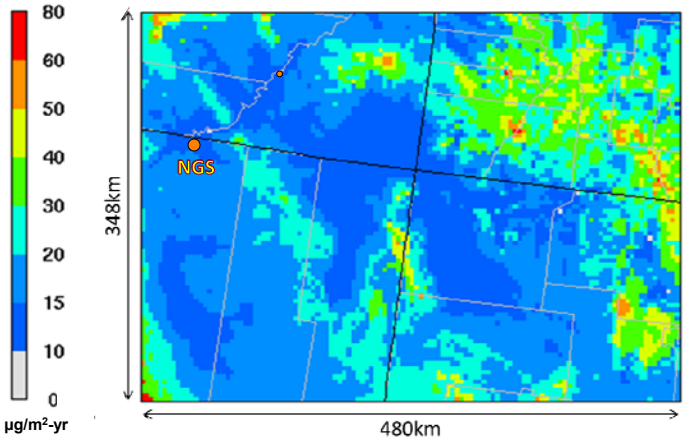
Annual Hg_{II+P}* Deposition Due to All Sources in 2020



- Annual Hg deposition near NGS ~ 13 µg/m²-yr

N3 (3 NGS Units) + Base China Scenario/Average of 5 years Met.

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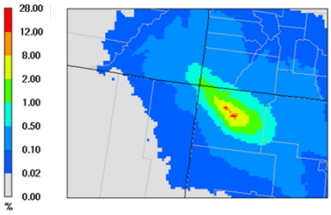
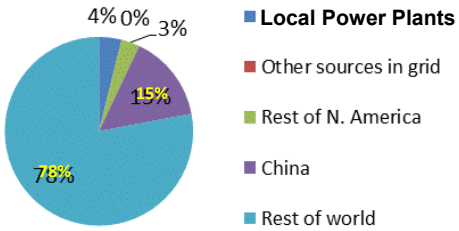
Regional contributions to mercury deposition

- Contribution of Four Corners Power Plant emissions to total mercury deposition



- Source contributions to mercury deposition, Lake Powell, AZ

Hg deposition = 13.3 µg/m²-y



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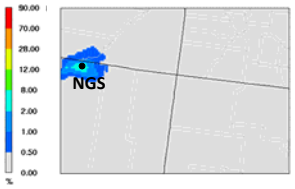
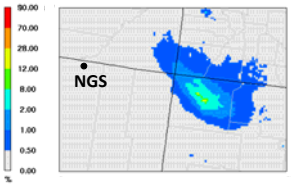
Relative Contribution to Hg Deposition in 2020 (N3 + Base China scenario)

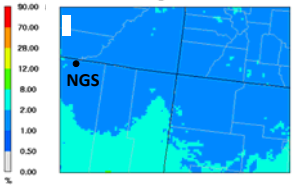
NGS alone
0 to 9%



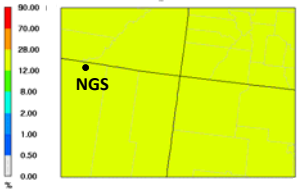
Other power plant sources in this domain
0 to 14%



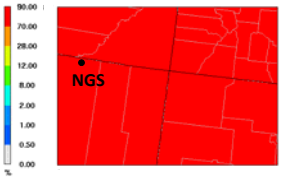
Rest of U.S.
1 to 11%



China
13 to 16%



Rest of World
71 to 84%



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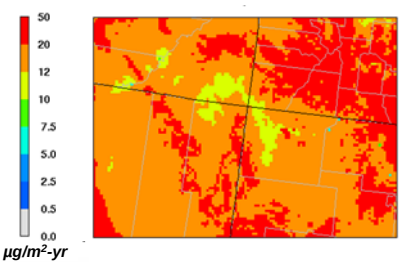
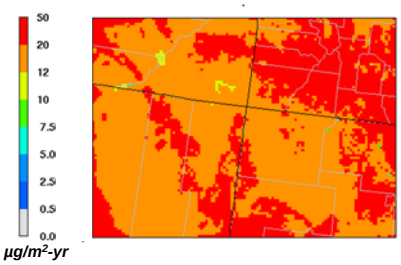
Contribution to Hg Deposition in 2020 from sources outside the local domain

Low China Scenario



High China Scenario



- **Peak Hg deposition in the modeling domain increases by about 10% from the low to high China scenarios**

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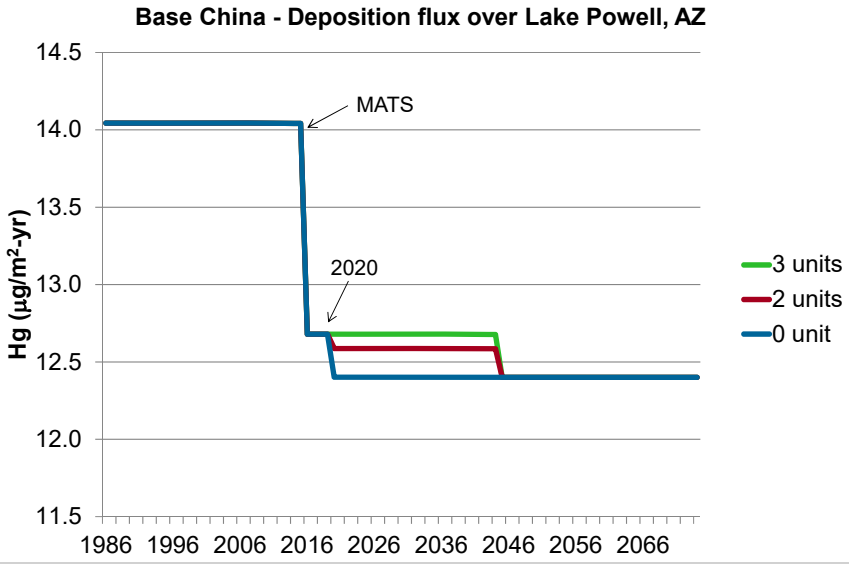
Timeline of predicted Hg deposition from 1986 to 2074 at Lake Powell (Glen Canyon dam)



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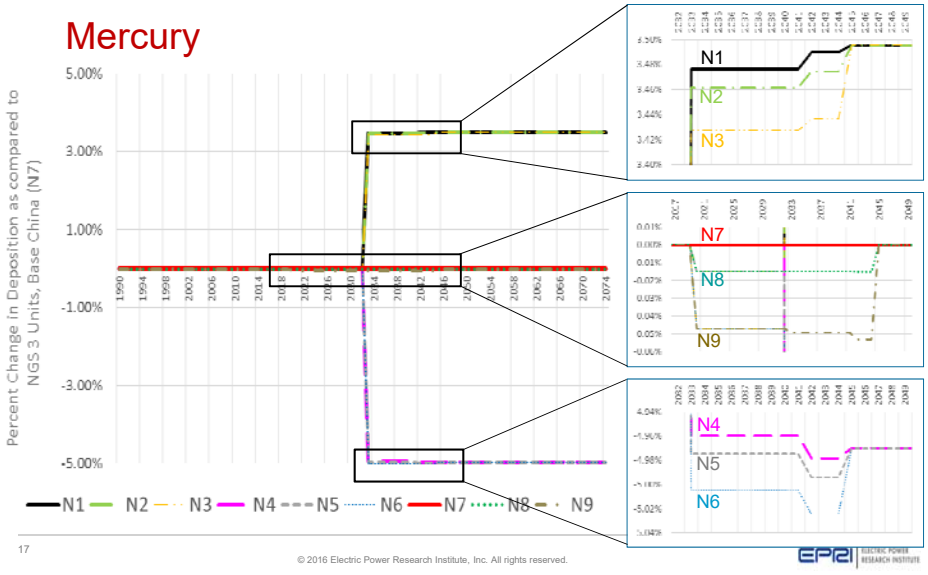
Average atmospheric deposition to the watershed

Percent Difference Compared to Base China Scenario



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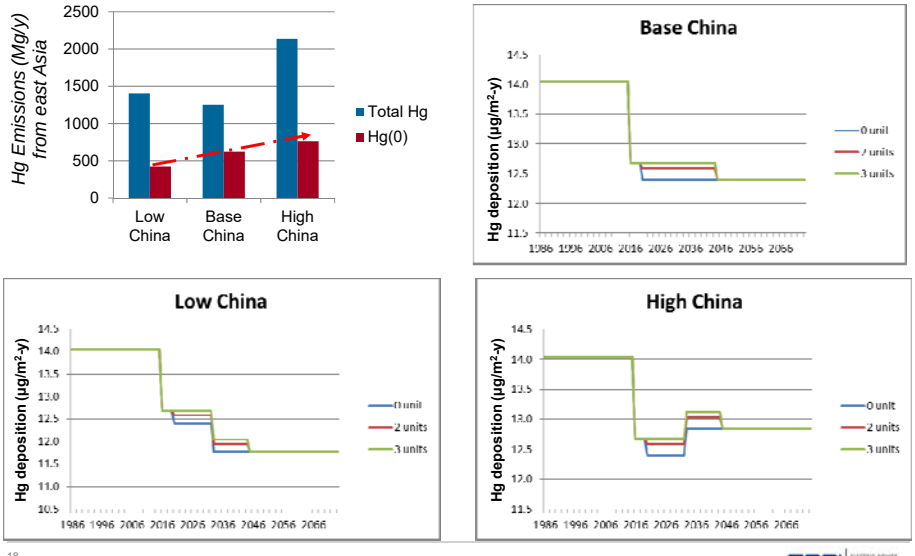
Three China mercury emissions scenarios: The importance of speciation



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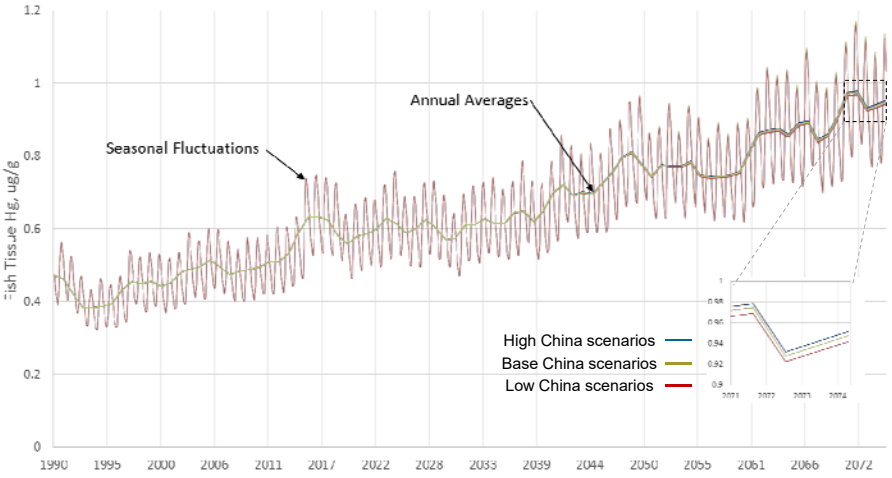
Watershed scenario simulation results

Fish Tissue Hg – Adult Colorado Pikeminnow (>400mm)

San Juan River above Lake Powell – All Scenarios



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